

# Endovascular Thrombectomy at a Government Tertiary Hospital in the Philippines: A Case Series

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## ABSTRACT

Endovascular thrombectomy (EVT) has revolutionized the management of acute ischemic stroke (AIS) caused by large-vessel occlusion, significantly improving outcomes worldwide. This single-center case series evaluated the early outcomes of EVT in AIS patients treated at this institution, focusing on its implications within a low- or middle-income country setting. The study aimed to assess the feasibility, safety, and efficacy of EVT, analyzing premorbid comorbidities, time to treatment, revascularization rates, procedural complications, and clinical outcomes. Five consecutive cases of AIS due to large-vessel occlusion treated with EVT were analyzed. The patients in this series were aged 21 to 75 years, all with a baseline modified Rankin Scale (mRS) score of 0. The average NIH Stroke Scale (NIHSS) score on admission was 17. Four patients received Alteplase before EVT within four hours of symptom onset. Successful recanalization (TICI 2b-3) was achieved in all cases. Post-thrombectomy, two patients developed re-occlusion, with one resulting in mortality. Among the patients, 40% achieved a favorable outcome, defined as a modified Rankin Scale (mRS) score of 2 at three months. This initial experience demonstrates promising results in achieving successful recanalization and improving clinical outcomes in AIS patients with large-vessel occlusion. However, the study also highlights challenges such as procedural complications and post-thrombectomy re-occlusion, underscoring the need for ongoing evaluation and optimization of patient selection and procedural protocols in low-resource settings. Future studies with larger sample sizes are warranted to further validate these findings and refine EVT protocols tailored to local healthcare contexts.

**Keywords:** Ischemic stroke, thrombectomy, time-to-treatment, large-vessel occlusion

## INTRODUCTION

Endovascular thrombectomy (EVT) has emerged as a transformative intervention in the management of acute ischemic stroke (AIS) resulting from large-vessel occlusion.<sup>1</sup> EVT has been associated with significantly improved clinical outcomes and reduced disability. Despite these advancements, the accessibility and implementation of EVT in low- and middle-income countries remain limited due to resource constraints and logistical challenges.<sup>2</sup> In sub-Saharan Africa and parts of Southeast Asia, for example, the availability of EVT is hampered by financial constraints and insufficient health system capacity.<sup>3</sup> Similarly, in Latin America, only a fraction of stroke patients receive EVT due to disparities in hospital resources and geographical limitations.<sup>4</sup> In the Philippines, stroke care faces persistent challenges due to systemic healthcare limitations. According to Collantes et al., the country's healthcare system struggles with inadequate resources and infrastructure to support advanced stroke interventions, including EVT.<sup>5</sup> The



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scarcity of neurointerventionists, high procedural costs, and disparities in stroke-ready hospitals further exacerbate these challenges, limiting EVT's widespread implementation in government hospitals.

In April 2024, the Philippine General Hospital (PGH) introduced endovascular EVT as a treatment modality for AIS, marking a significant milestone in stroke care within the country. The evaluation of EVT at PGH encompassed several critical aspects. Firstly, the feasibility of implementing EVT within the existing healthcare framework was thoroughly assessed. Secondly, the safety of EVT was carefully monitored, focusing on complication rates and adverse events. Lastly, its efficacy was evaluated by examining clinical outcomes, including functional independence, neurological improvement, and overall survival rates. This development was officially documented in the 2024 revision of the Operations Manual of the Brain Attack Team (BAT), underscoring its importance in advancing stroke management at PGH.<sup>6</sup>

This study aimed to provide valuable insights into the practicality of integrating EVT into stroke care in a resource-limited setting and to identify potential barriers and facilitators to its successful implementation. The findings contributed to the ongoing efforts to enhance stroke care in the Philippines and may serve as a model for other low- and middle-income countries facing similar challenges.

## METHODS

This case series included five consecutive cases of AIS due to large-vessel occlusion treated with EVT in this government tertiary hospital from April to June 2024. All participants provided informed consent. Inclusion criteria were patients aged 18 years and above, presenting with AIS due to large-vessel occlusion. In this institution, patient eligibility for EVT is determined based on the following criteria: (1) presence of a causative large vessel occlusion; (2) age  $\geq 18$  years; (3) National Institutes of Health Stroke Scale (NIHSS) score  $\geq 6$ ; (4) Alberta Stroke Program Early CT Score (ASPECTS)  $\geq 6$ ; and (5) the ability to initiate treatment (groin puncture) within six hours of symptom onset.<sup>6</sup>

As for the choice of initial neuroimaging, non-contrast computed tomography (CT) is the first-line imaging modality to assess ischemic stroke and rule out hemorrhage. CT angiography (CTA) is preferred for its speed and ability to detect intracranial and extracranial occlusions. When available, CT perfusion (CTP) helps assess salvageable tissue, particularly in late-window cases. MRI/MRA is selectively used for wake-up strokes, posterior circulation strokes, or when iodinated contrast is contraindicated. Diffusion-weighted imaging (DWI) and fluid-attenuated inversion recovery (FLAIR) sequences aid in estimating stroke onset, while MR perfusion (MRP) can guide extended-window treatment decisions. The choice between CT- and MR-based imaging depends on clinical presentation and resource availability. Post-EVT, patients are monitored for 24

hours, with follow-up CT/CTA or MR/MRA to assess for hemorrhage, re-occlusion, or other complications.

The data collected encompassed baseline characteristics, premorbid comorbidities, NIHSS scores on admission, time from symptom onset to treatment, use of intravenous thrombolysis with Alteplase, procedural details, immediate revascularization outcomes [Thrombolysis in Cerebral Infarction (TICI) score], procedural complications, and clinical outcomes at discharge. The baseline characteristics, treatment details, and outcomes, with revascularization success defined as a TICI score of 2b-3 were described. Clinical outcomes were assessed using the modified Rankin Scale (mRS) score at discharge.

## RESULTS

This study included five patients who underwent EVT for AIS, providing detailed accounts of their demographics, clinical characteristics, and outcomes (Table 1). The patients ranged in age from 21 to 75 years, with a mean age of 48 years, and 60% were male. The comorbidities among the patients included cardiac dysrhythmia (specifically 3<sup>rd</sup> degree atrioventricular block), hypertension, dyslipidemia, anti-phospholipid syndrome (APAS), and rheumatic heart disease. All patients had a baseline mRS score of 0, indicating no premorbid disability. Additionally, only one patient was on antithrombotic therapy (aspirin) before stroke onset. The clinical presentation primarily involved right-sided weakness, and the NIHSS scores on admission varied, with an average score of 17, indicating severe stroke. The vessel occlusions were predominantly located in the left middle cerebral artery, and the treatment techniques utilized included combined methods, stent retriever, or aspiration catheter only.

Door-to-needle times and ictus-to-puncture times varied significantly among the patients, reflecting differences in response times. In this institution, suspected acute ischemic stroke patients follow a 'direct-to-CT' protocol for rapid assessment and intravenous thrombolysis (IVT) eligibility. Notably, four of the patients received intravenous Alteplase before EVT, administered within four hours of symptom onset. Patients in this series requiring EVT were transferred to the angiography suite as soon as possible. Unlike high-resource centers that increasingly adopt direct-to-angio protocols to expedite EVT, this institution utilizes a stepwise imaging approach due to logistical constraints, ensuring careful selection while optimizing available resources. The EVT procedures were performed using standard techniques, achieving successful recanalization (TICI 2b-3) in all cases. During the procedure, a femoral puncture was performed, and an 8F introducer sheath was inserted into the right common femoral artery under local anesthesia. A 5F Berenstein II catheter, advanced over a hydrophilic guidewire, was navigated through the target vessels. Various microcatheters, microwires, a stent retriever, and an aspiration catheter were utilized during the interventions. Following the procedure,

**Table 1.** Patient Demographics, Clinical Presentation, Laboratory Work-up and Imaging, Intervention, and Clinical Outcomes

Characteristics	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5
<b>Demographics</b>					
Age	71	49	55	21	75
Sex	Female	Male	Male	Male	Female
<b>Comorbidities</b>					
	Cardiac dysrhythmia, Hypertension, Dyslipidemia	APAS	Hypertension	Rheumatic heart disease	Hypertension, Dyslipidemia
<b>Use of antithrombotics prior to stroke onset</b>					
	Yes	No	No	No	No
<b>Clinical presentation</b>					
	Right sided weakness	Decreased verbal output	Right sided weakness	Right sided weakness	Right sided weakness
<b>NIHSS on admission</b>					
	23	14	15	10	18
<b>Vessel involved</b>					
	Left ICA	Basilar artery	Left MCA (M1)	Left MCA (M1)	Left MCA (M1)
<b>ASPECTS or pc-ASPECTS score</b>					
	7	8	7	6	6
<b>IVT</b>					
Door to needle (mins)	30	68	57	NA	55
<b>EVT</b>					
Door to puncture (mins)	120	220	115	211	227
Ictus to puncture (mins)	210	334	245	371	267
Technique performed	Combined method	Stent retriever only	Combined method	Aspiration catheter only	Aspiration catheter only
Number of passes	6	1	2	1	1
TICI grade	2b	3	3	3	3
Complications	Contrast-induced encephalopathy	Re-occlusion	Re-occlusion	None	None
<b>Length of hospital Stay</b>					
	10	21	6	6	17
<b>NIHSS on discharge</b>					
	21	NA	15	2	14
<b>mRS on discharge</b>					
	5	6	5	2	4
<b>mRS at 3 months</b>					
	4	6	4	0	2

NIHSS - National Institutes of Health Stroke Scale, ASPECTS - Alberta Stroke Program Early CT Score, pc-ASPECTS - Posterior circulation Acute Stroke Prognosis Early CT Score, IVT - Intravenous Thrombolysis, EVT - Endovascular Thrombectomy, TICI - Thrombolysis in Cerebral Infarction, mRS - modified Rankin Scale, ICA - Internal Carotid Artery, MCA - Middle Cerebral Artery, APAS - Antiphospholipid Syndrome, NA - not applicable

patients were closely monitored and subsequently admitted to the intensive care unit for continuous observation. A repeat cranial computed tomography (CT) or magnetic resonance imaging (MRI) angiogram was performed for each patient post-procedure to assess for any re-occlusion.

Outcomes on discharge, assessed using NIHSS and mRS scores, ranged from favorable to severe disability, with hospital stays varying from 6 to 21 days. Notably, two patients developed re-occlusion following thrombectomy, and one of these cases resulted in mortality. Re-occlusion post-EVT was initially identified on follow-up CTA. However, distinguishing true thrombotic re-occlusion from vessel dissection or vasospasm would have required additional imaging, such as high-resolution CTA, digital subtraction angiography (DSA), or MRI. These modalities were not performed due to resource and time constraints.

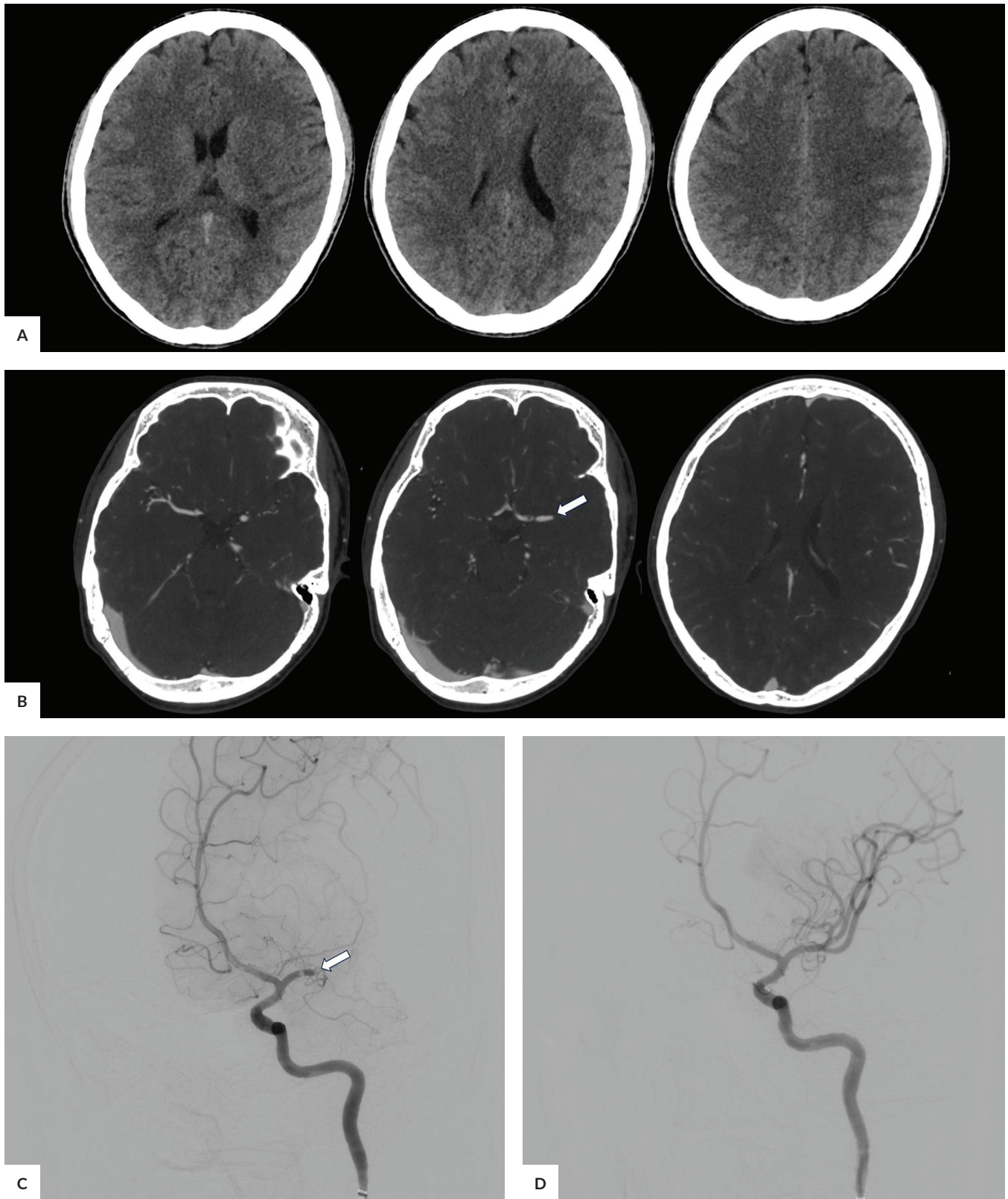
The incidence of intracerebral hemorrhage following intravenous thrombolysis (IVT) and/or endovascular thrombectomy (EVT) was 0%. The mean mRS scores were 4 at discharge and 3 at three months. Among these patients, 40% achieved a favorable outcome, defined as a modified Rankin Scale (mRS) score of 2 at three months. In particular,

Patient 4 demonstrated full recovery, attaining an mRS score of 0 at three months. The cranial imaging results for this patient were described below (Figure 1), providing visual confirmation of the successful intervention and recovery process. This detailed examination highlights the diverse range of patient responses to EVT and underscores the need for ongoing monitoring and tailored post-procedural care.

## DISCUSSION

The introduction of EVT at a government tertiary hospital represents a significant advancement in stroke care for the country, especially in the context of the numerous challenges faced by the Philippine healthcare system. This includes insufficient resources to support advanced interventions such as EVT.<sup>5</sup>

A similar local study conducted by Constantino et al. evaluated the profile and discharge outcomes of EVT for AIS at a private tertiary hospital in the Philippines. The study demonstrated that while successful reperfusion was achieved in 92.3% of patients, only 22.6% had favorable functional outcomes upon discharge, with a 29% mortality



**Figure 1.** A 21-year-old male with rheumatic heart disease. (A) plain cranial CT scan demonstrated a hyperacute left middle cerebral artery infarct ASPECTS 7. (B) CTA showed occlusion of the distal M1 segment of the left middle cerebral artery (arrow). (C) Cerebral angiogram of the left internal cerebral artery again revealed an occlusion of the distal M1 segment of the left middle cerebral artery (arrow). (D) Post endovascular thrombectomy angiogram showed TIC1 3 reperfusion.



rate. These findings underscore the complexity and challenges associated with EVT as a treatment option for large-vessel AIS.<sup>7</sup> Despite its potential to improve clinical outcomes, the study highlights the need for enhanced protocols, better post-procedural care, and comprehensive training to maximize the benefits and mitigate the risks associated with EVT.<sup>7</sup>

The evaluation of EVT at this institution involved a comprehensive assessment of feasibility, safety, and efficacy within the existing healthcare framework. Key aspects such as the availability of necessary equipment, trained personnel, and adherence to established protocols were critically examined. Despite the logistical challenges, the study demonstrated that with appropriate infrastructure and training, EVT could be effectively integrated into the stroke care pathway, even in resource-limited settings. The high success rate of recanalization (TICI 2b-3) in all cases is indicative of the procedure's feasibility when conducted under optimal conditions.<sup>8</sup> The safety profile of EVT was also documented, with a particular focus on procedural complications. The study found that while EVT is generally safe, complications such as restenosis and/or re-occlusion can occur, necessitating vigilant post-procedural monitoring. Surveillance for restenosis and/or re-occlusion after EVT includes regular cranial imaging with angiogram and clinical monitoring with neurological assessments. Interventions may involve pharmacological strategies like antiplatelet or anticoagulant therapy or repeat endovascular procedures such as balloon angioplasty or stent placement.<sup>8</sup> In this case series, two patients developed re-occlusion post-thrombectomy, leading to one mortality. These findings emphasize the need for ongoing surveillance and potential additional interventions to manage such complications effectively. Furthermore, the study highlights the importance of standardized protocols and continuous training to minimize risks and enhance patient safety.<sup>9</sup>

Efficacy outcomes were measured using the NIHSS and the mRS at three months.<sup>10</sup> The varying degrees of recovery among the patients, ranging from favorable outcomes (mRS 1) to severe disability, reflect the complexity of stroke recovery and the multiple factors influencing it. Stroke outcomes vary significantly between well-resourced and resource-limited centers due to disparities in imaging availability, technical expertise, and post-stroke care. High-resource centers benefit from faster reperfusion, experienced neurointerventionists, and dedicated stroke units for intensive monitoring and rehabilitation. In contrast, resource-limited facilities often face treatment delays, a shortage of specialists, and limited post-stroke care, leading to worse functional outcomes. For instance, in sub-Saharan Africa and parts of Southeast Asia, EVT availability is restricted by financial constraints and inadequate healthcare capacity.<sup>3</sup> Similarly, in Latin America, only a fraction of stroke patients receive EVT due to disparities in hospital resources and geographical barriers.<sup>4</sup> Addressing these challenges requires strategic investment in stroke infrastructure, physician training, and optimized care

pathways to improve EVT accessibility and enhance patient outcomes in underserved regions.

In this case series, forty percent of patients achieved a favorable outcome at three months, with Patient 4 demonstrating full recovery, underscoring the potential for excellent recovery with timely and effective intervention. The successful implementation of EVT at PGH marks a major milestone, aligning the institution with global standards in stroke management and providing a new avenue for improved clinical outcomes for patients.<sup>11</sup>

The authors acknowledge several limitations, including the single-center design, retrospective data collection, and biases inherent to a case series. Resource constraints and variability in treatment at a government tertiary hospital in the Philippines may further limit generalizability. Despite this, the study provides valuable insights for more research on EVT in similar settings. To further validate these results and refine EVT protocols suitable for local healthcare settings, future studies with larger, more diverse populations are needed. Despite these limitations, the insights gained from this study are critical for advancing stroke care in the Philippines and can provide a valuable framework for other low- and middle-income countries facing similar healthcare challenges. These findings contribute to the broader effort of improving stroke management and outcomes in resource-limited environments.

## CONCLUSION

The introduction of EVT at this government tertiary institution marks a significant advancement in stroke care in the Philippines, highlighting the country's commitment to adopting cutting-edge medical interventions. This study offers preliminary evidence of the feasibility and potential benefits of EVT in a low- or middle-income country setting, demonstrating that with appropriate infrastructure and training, successful implementation is possible. The findings underscore the importance of ongoing efforts to optimize treatment protocols, including refining procedural techniques and ensuring adequate post-procedural care to address the unique challenges posed by resource-limited environments. Furthermore, the study emphasizes the necessity of continuous education and training for healthcare professionals to maintain high standards of care and improve patient outcomes. These efforts are crucial to maximizing the benefits of EVT for AIS patients and can serve as a model for other similar settings striving to enhance their stroke care capabilities.

### Statement of Authorship

All authors certified fulfillment of ICMJE authorship criteria.

### Author Disclosure

All authors declared no conflicts of interest.

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